



Paying Attention to Mathematics Education: Growing Accessible Interactive Networked Supports (GAINS) for Administrators

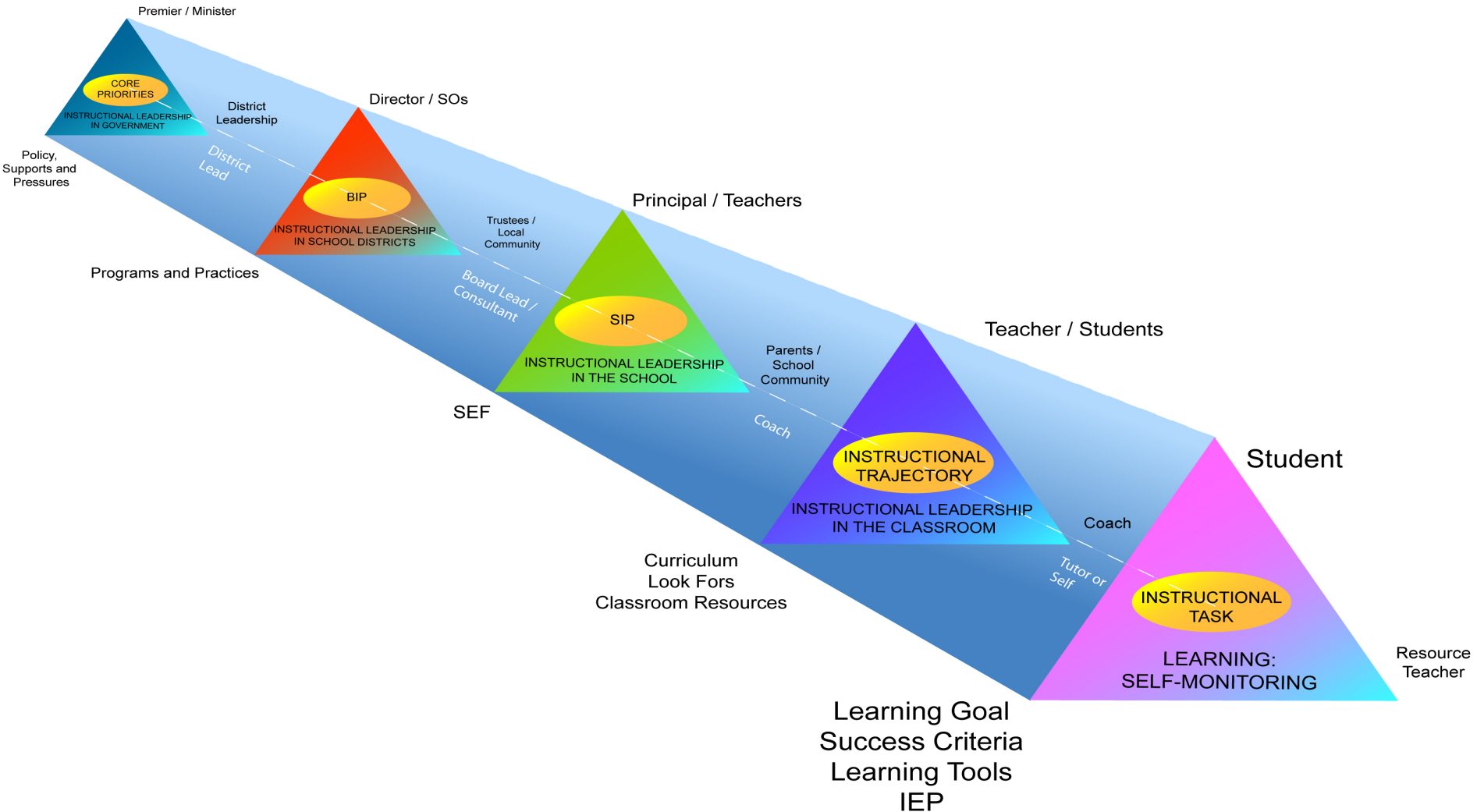
Professional Learning Series for
School and System Leaders

Reach Every Student Goal: Students will have access to differentiated instruction and assessment that is responsive to the unique needs of the learner to support high achievement, well-being and learning for life.

Close the Gap Goal: Students will benefit from School Improvement Plans (SIP), classroom instruction and specific interventions that are informed by an analysis of provincial, system and classroom assessments, achievement and learning skills trends for specific student groups including but not limited to First Nation, Métis and Inuit (FNMI), Special Education, English Language Learners (ELL) and gender.

Assessment Goal: Students will participate in instruction that is informed by assessment for, as and of learning.

Instructional Core



Who are we?

- Find three others who have the same coloured sheet of paper.
- Create a sentence that includes all four words. The sentence should tell us something about your group.

Connecting Leadership to Teaching and Learning Math

“Without knowledge that connects subject matter, learning and teaching to acts of leadership, leadership floats disconnected from the very processes it is designed to govern.” (Stein and Nelson, 2003)

Learning Goals

- We will understand how to create/develop effective questions to support teacher practice and student learning.
- We will understand how to identify open questions and accountable talk as methods of assessment *for* and *as* learning within the three part math lesson.

Success Criteria

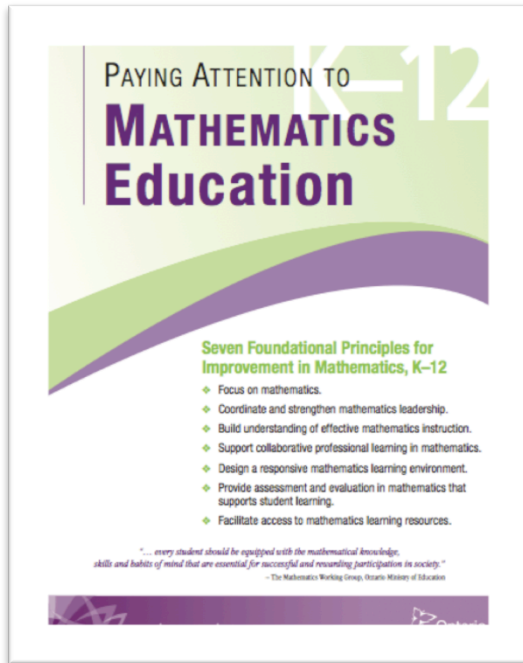
- Principals will create success criteria to support effective math classroom visits in all Grades

Focus for Today

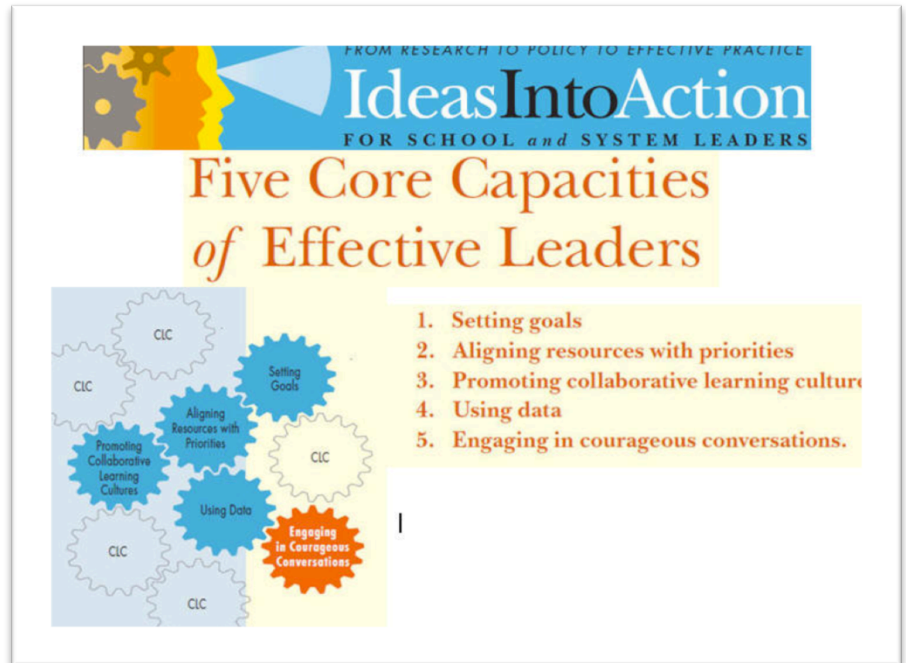
- It's all about **thinking**
- Teaching/Learning through the Mathematical Processes
- Open Questions
- Leading Conversations

Frameworks

Foundational Principles



5 Core Capacities



Five Core Capacities

1. Setting goals
2. Aligning resources with priorities
3. Promoting collaborative learning cultures
4. Using data
5. Engaging in courageous conversations.

Discussion Tool

A DISCUSSION TOOL FOR

PAYING ATTENTION TO MATHEMATICS EDUCATION, K–12

To be used in board and school planning, as a discussion tool, to assess implementation of each of the seven foundational principles:

- ❖ Focus on mathematics.
- ❖ Coordinate and strengthen mathematics leadership.
- ❖ Build understanding of effective mathematics instruction.
- ❖ Support collaborative professional learning in mathematics.
- ❖ Design a responsive mathematics learning environment.
- ❖ Provide assessment and evaluation in mathematics that supports student learning.
- ❖ Facilitate access to mathematics learning resources.

MATHEMATICS FOUNDATIONAL PRINCIPLE:

CRITERIA	Developing →	Building →	Consolidating →	Sustaining →	Innovating
Breadth	We are collecting information about this foundational principle.	We are implementing strategies related to this foundational principle in some schools and classrooms board-wide.	We are implementing strategies related to this foundational principle in many schools and classrooms board-wide.	We are re-examining the quality and effectiveness of the implementation of this foundational principle and reviewing new developments in the field.	We are extending our practice related to this foundational principle.
Depth	We are exploring the components related to implementing this foundational principle.	We are building system knowledge and monitoring and refining our actions related to this foundational principle.	We are monitoring the implementation and impact of this foundational principle to inform adjustments to planning and practice.	We are evaluating the impact of implementation of this foundational principle on student learning and using this information to refine our practice.	We are generating new knowledge to enhance our practice related to this foundational principle.
Shared Practice	We are preparing to implement this foundational principle.	We are inquiring collectively to increase our skills and knowledge related to this foundational principle.	We are routinely sharing effective practices and processes related to this foundational principle.	We are integrating our shared learning into our practices and processes related to the implementation of this foundational principle.	We are exploring new goals related to implementation of this foundational principle.

1. What evidence do we have? (student, teacher, leader levels)
2. What will we do next? (short-term, long-term)

I could ask a student:

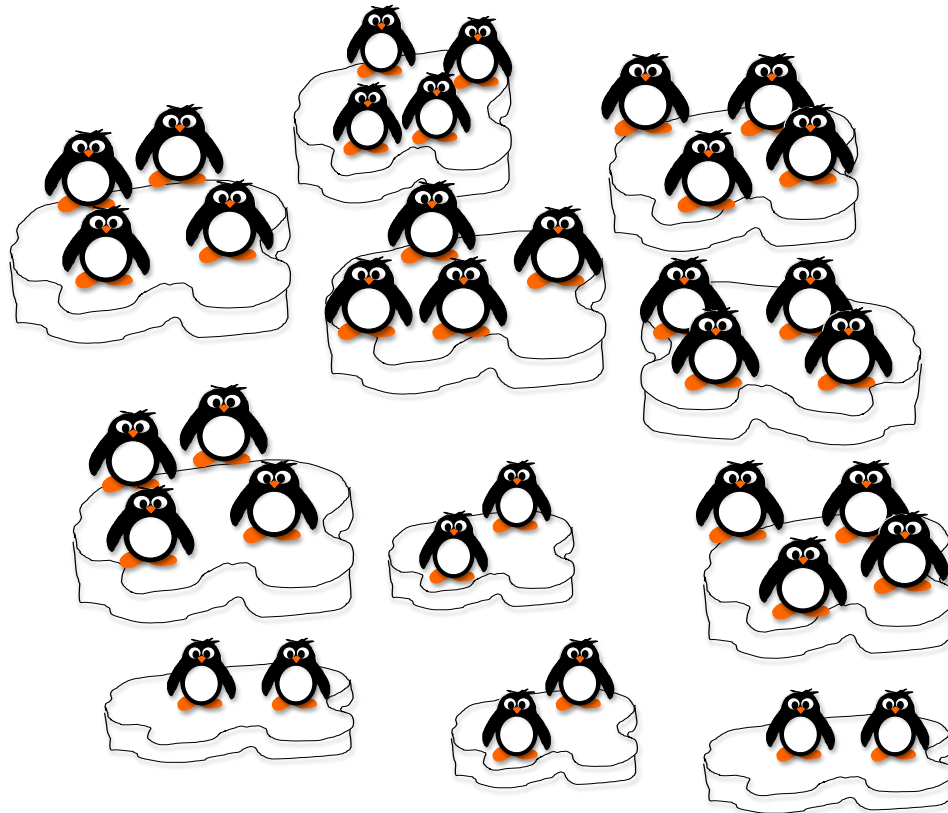
$$53 \times 48 = ?$$

OR

I could ask a student:

- Choose two numbers around 50 to multiply.
- What do you know, even before you multiply about the answer?
- What different ways are there to figure out that answer?

Visual learner?



Does this picture show multiplication?

Foundational Principles

❖ Foundational Principle

Focus on mathematics.

“As teachers become more familiar with which ideas are more complex for students and why, they are better able to ensure that their instruction is at the appropriate developmental level for students, and that it challenges students’ mathematical conceptions in appropriate ways. This minimizes the likelihood of students developing mathematical misconceptions.”

– Small, M. (2009). *Making math meaningful to Canadian students, K–8*. Toronto, ON: Nelson Education.

All educators – classroom teachers, early childhood educators, school principals and other instructional leaders in the education system – use a variety of critical thinking and problem-solving strategies to engage all students in making connections between content and process as they work toward a thorough understanding of mathematics.



Learning to Listen to Students' Mathematical Thinking

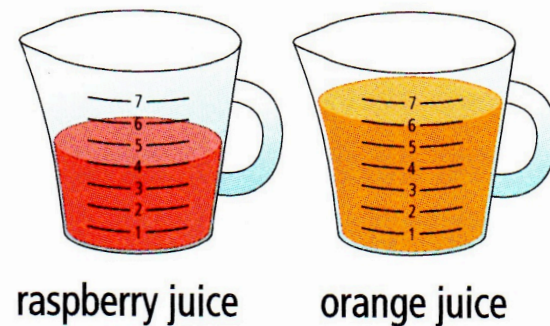
- Principals need to listen to students' mathematical thinking and assess teachers' capacity to also listen and to make instructional moves that help students' mathematical thinking progress



Example 2: Apply Ratios to Recipes

Lena has a recipe for a fruit punch that calls for 4 cups of raspberry juice and 6 cups of orange juice.

- a) How much orange juice should Lena use if she only uses 2 cups of raspberry juice?
- b) Suppose Lena wants to make 50 cups of punch for a family gathering. How much of each type of juice should she use?



Maybe...

- One punch that has 4 cups of orange juice and some pineapple juice tastes exactly the same as one with 18 cups of pineapple juice, but more than 4 cups of orange juice. What could the other cup measures be?

Graffiti

Read the titles on the chart paper at your table and record your immediate thoughts and ideas as related to what you see and hear in your school.

Teaching and Learning through the Mathematical Processes

Five Minutes – During Viewing

- View the video clip and record any new learning

Grade 9 Applied Lesson

Kawartha Pine Ridge DSB

Grade 9 Applied Math Class



Two Roles

Participants

“Engaged in the Activity”

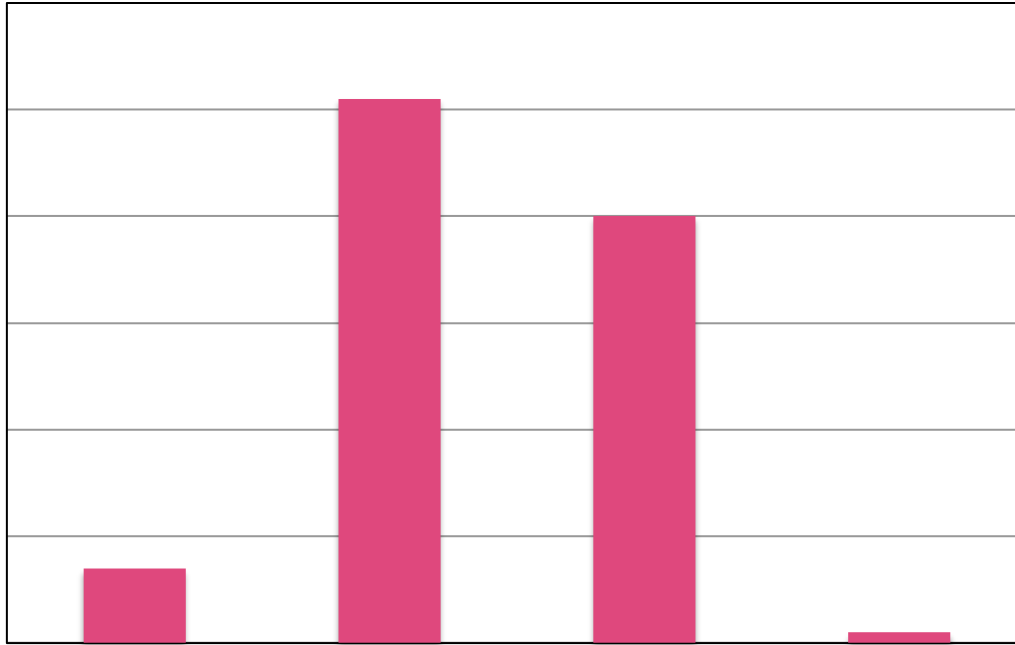
Observers

Identify the Mathematical Process the participants engage with during the activity

Checklist and Evidence of the Mathematical Processes

	Reasoning and Proving	Reflecting	Selecting Tools and Computational Strategies	Connecting	Representing
	apply reasoning skills to justify conclusions	demonstrate that they are reflecting on monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem		Make connections among mathematical concepts and relate mathematical ideas to situations or phenomena drawn from other contexts	select and apply the appropriate representations
Minds On					
Action					
Consolidation					

Minds On



Tell a story to your learning partner
what you think this graph is about.

Big Idea

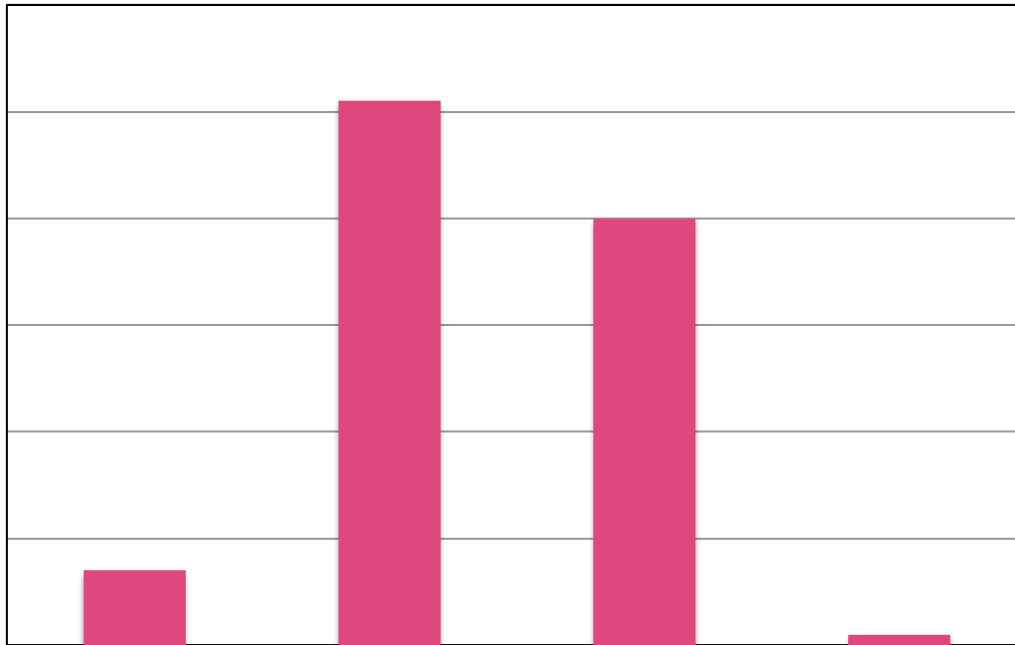
- Graphs are powerful data displays because they quickly reveal a great deal of information.

Learning Goal

- To read and interpret a bar graph.

Action

- Create 3 possible table of values for the graph.



Possible Solutions

Months	Rain (cm)

Months	Rain (cm)

Months	Rain (cm)

BREAK!



Consolidate

- Share with another group at your tables.
- Be prepared to share one key idea you learned relating back to our learning goal

Consolidate

- What one piece of information can we put on the graph so that we all get the same table of values?

Where's the math?

- We can tell the values of each bar if one value is given.
- We can also find the differences between them, total of all of them and the mean.
- Unless the scale is 1 or 2, interpreting the graph is mostly estimating.

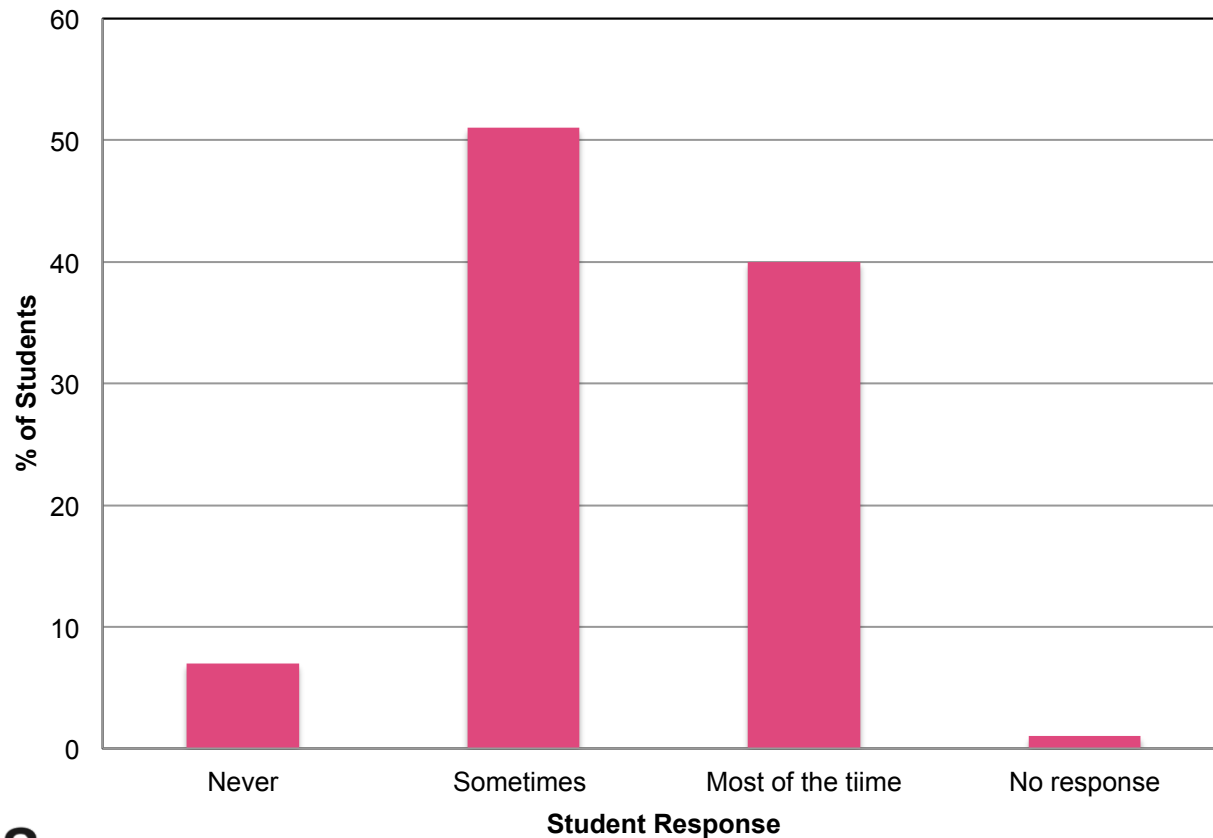
Where's the math?

- We want students to know that we use graphs since visual presentation of data is much quicker and easier to see than tabular or verbal representations

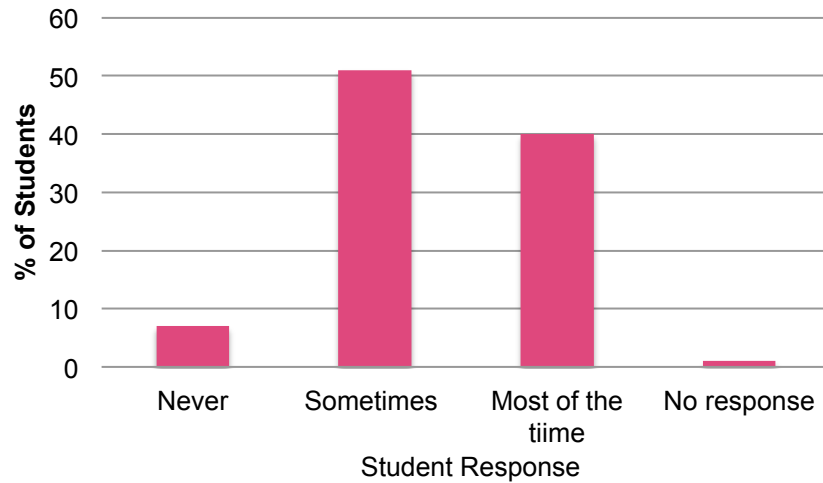
Kindergarten lesson



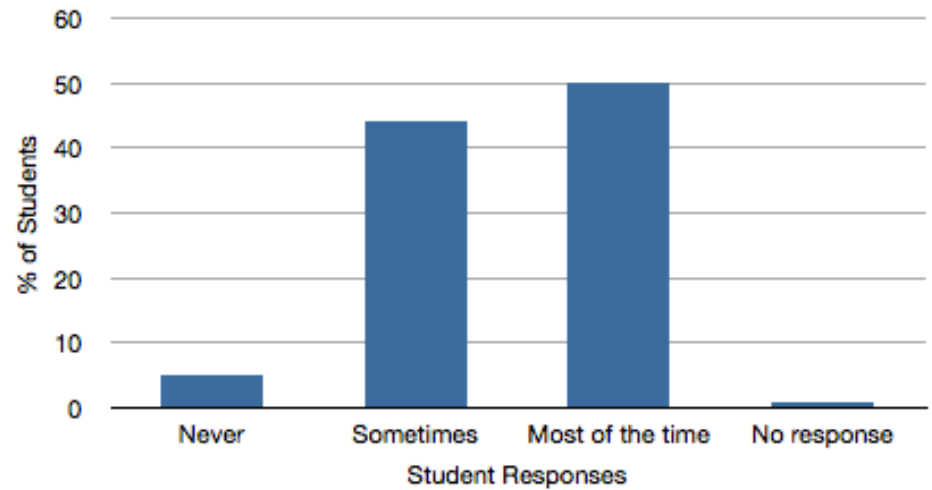
“I like mathematics” – Grade 6 Provincial Results, 2009-2010



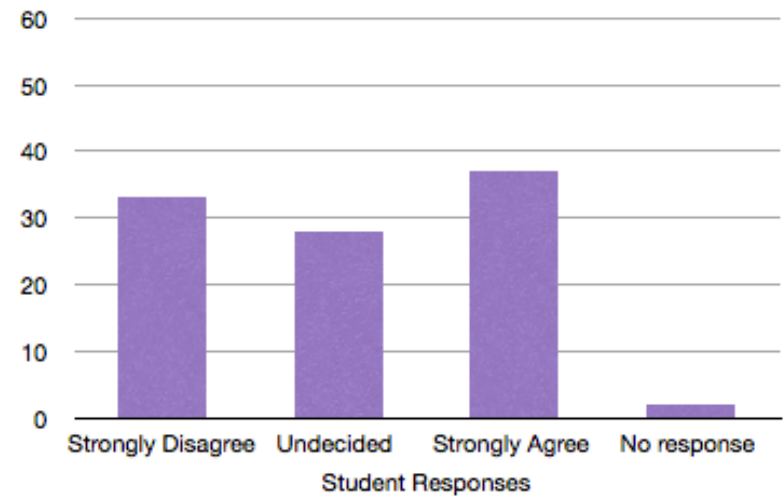
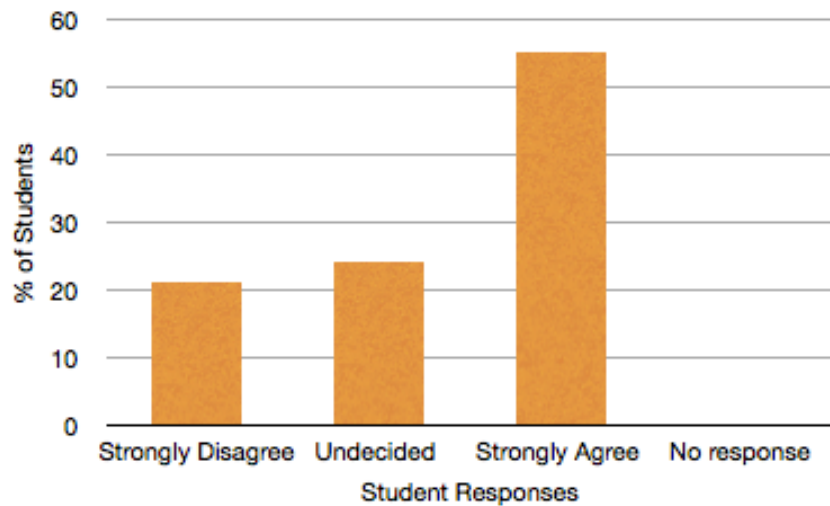
Grade 3



Grade 6



Grade 9 Applied and Grade 9 Academic



Which Mathematical Processes were participants engaged in?

Checklist and Evidence of the Mathematical Processes

	Reasoning and Proving	Reflecting	Selecting Tools and Computational Strategies	Connecting	Representing
	apply reasoning skills to justify conclusions	demonstrate that they are reflecting on monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem		Make connections among mathematical concepts and relate mathematical ideas to situations or phenomena drawn from other contexts	select and apply the appropriate representations
Minds On					
Action					
Consolidation					

Navigating the Math GAINS website

The screenshot displays the Math GAINS website. At the top is the MathGAINS logo. Below it is a navigation bar with links: Home, Teachers, Professional Learning Facilitators, School Administrators, Superintendents, and Contact Us. A search bar with 'Google™ Custom Search' and a 'Site Search' button is also present. On the left is a sidebar menu with 'Math GAINS Home' and 'Learning Materials' (which includes links to CLIPS, Continuum & Connections, EQAO Supports, Gap Closing, Guides to Effective Instruction K-6, Manipulatives Supports, Math Processes, Summative Units, Technology Supports, TIPS, and WINS). The main content area is titled 'School Administrators' and contains a table with information about the Ontario Leadership Framework.

Math GAINS Home >

Learning Materials ▾

- ▶ CLIPS
- ▶ Continuum & Connections >
- ▶ EQAO Supports
- ▶ Gap Closing
- ▶ Guides to Effective Instruction K-6
- ▶ Manipulatives Supports >
- ▶ Math Processes >
- ▶ Summative Units >
- ▶ Technology Supports >
- ▶ TIPS
- ▶ WINS >

School Administrators

Core Leadership Capacity	Sample domains and related practices of the Ontario Leadership Framework, with links to EduGAINS resources and suggested uses of these resources in developing and practising these practices		
1. Setting Goals	Setting Directions	Leading the Instructional Program	Securing Accountability
	Ensures the vision is clearly articulated, shared, understood and acted upon by all	Fosters a commitment to equity of outcome and to closing the achievement gap	Aligns school targets with board and provincial targets
2. Aligning Resources with Priorities	Setting Directions	Leading the Instructional Program	Securing Accountability
	Ensures creativity, innovation and the use of appropriate technologies to achieve excellence	Ensures that learning is at the centre of planning and resource management	Makes connections to ministry goals to strengthen commitment to school improvement efforts
3. Promoting Collaborative Learning Cultures	Building Relationships and Developing People	Developing the Organization	Leading the Instructional Program
	Acknowledges and celebrates the achievements of individuals and teams	Builds a collaborative learning culture within the school and actively engages with other schools to build effective learning communities	Develops professional learning communities to support school improvement
4. Using Data	Setting Directions	Leading the Instructional Program	Securing Accountability



Before Day Two Arrives...

1. Participate in Webinar

The Journey of a Principal in Improving Mathematics Teaching and Learning

March 20th, 4:00 pm (Register for this webinar)

2. View Adobe Presenters

- Focus on MathGAINS for School and System Leaders
- Aligning the System to the Instructional Core

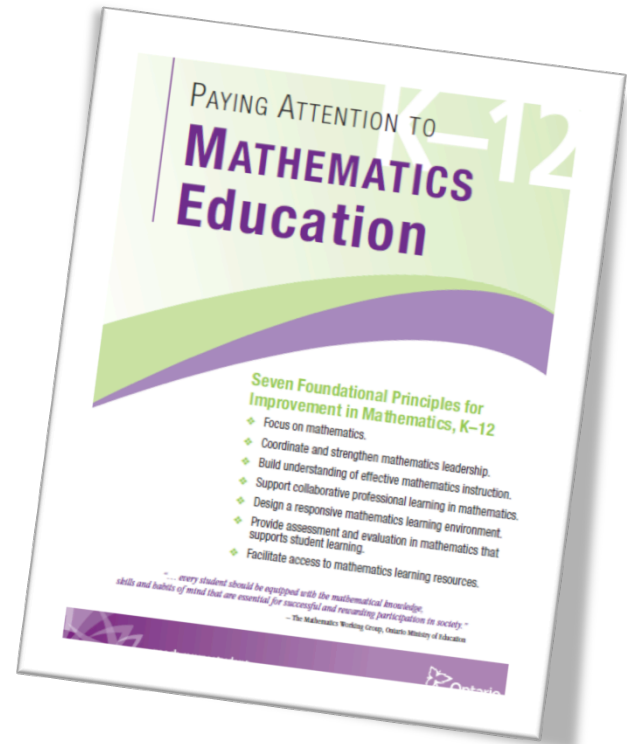


Visit our wiki

<http://plm2012.wikispaces.com/>

Day Two

- Thunder Bay – April 11th
- Toronto – April 12th



LUNCH BREAK



Minds On

Look at the video.

What questions come to mind?

What is the math problem here?



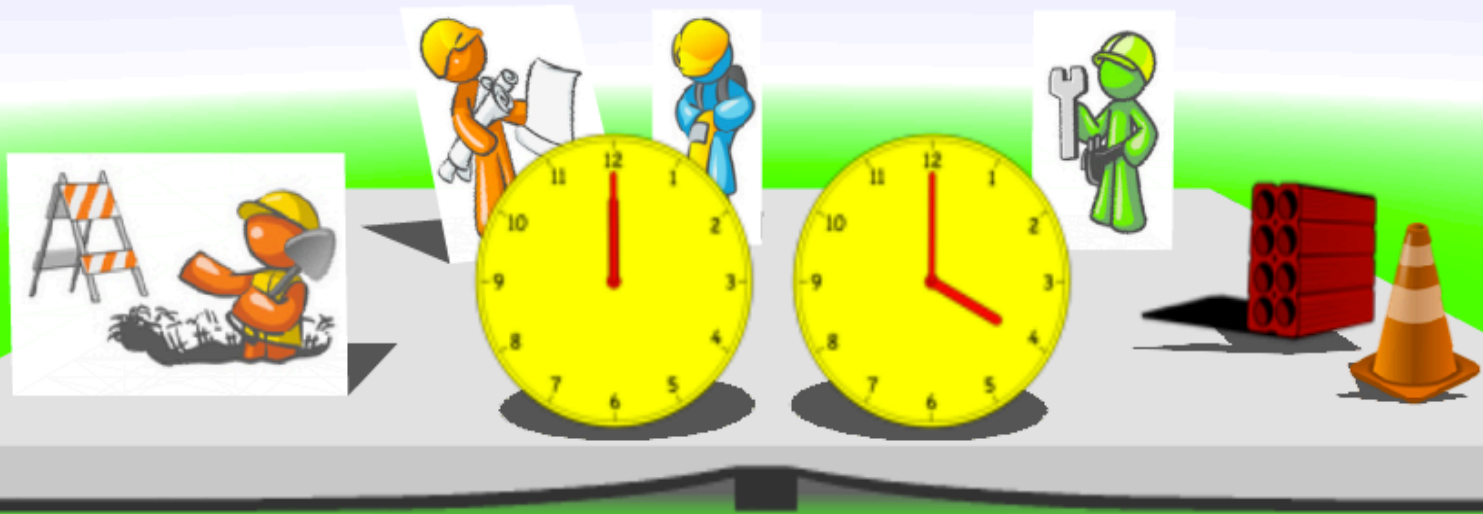
Where's the math?

Possible Question

What do I need to do to fix the mistake I made mixing Kipper's food?

Learning Goal

Reasoning about whether a situation describes proportional reasoning

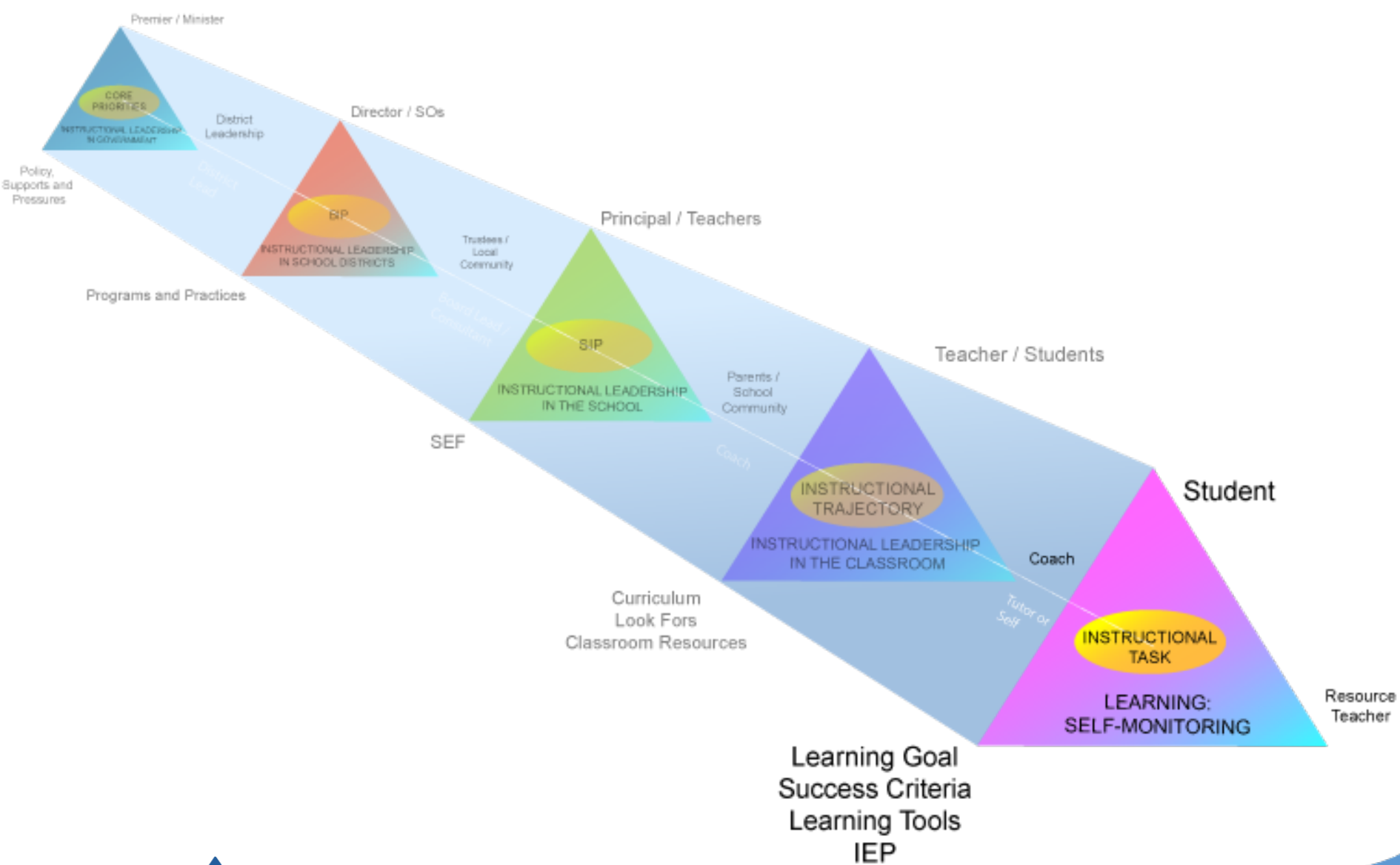


If it takes 4 people 6 hours to repair a road, how long will it take 9 people to do the job if they work at the same rate?

Solve the Problem

With your learning partner,
solve the problem.

What did you notice about
the problem?



If it takes 4 people 6 hours to repair a road, how long will it take 9 people to do the job if they work at the same rate?

There are 5 extra people.

takes 4 people 6 hours
5 people 5 hours
6 people 4 hours
7 people 3 hours
8 people 2 hours
9 people 1 hour.

It will take 9 people
1 hour to do the
same job.

I noticed that you decided if there was an extra person, it would take exactly one less hour.

How did you decide that?

If it takes 4 men 6 hours to repair a road, how long will it take 9 men to do the job if they work at the same rate?

$$\frac{4}{6} = \frac{9}{t}$$

$$4t = 54$$

$$t = 13.5 \text{ hours?}$$

$$9 \div 4 = 2.25$$

$$6 - 2.25 = 3.75 \text{ hours}$$

$$4 \times 6 = 24 \div 9 = 2.6 \text{ hrs}$$

$$4 \div 6 = 0.66 \text{ per person}$$

$$0.66 \times 9 = 6 \text{ hrs.}$$

I noticed you have 4 different answers on the page. Which of them do you think is correct?

Could there be more than one correct answer?

Which makes the most sense to you?

If it takes 4 men 6 hours to repair a road, how long will it take 9 men to do the job if they work at the same rate? *Show and explain all your work.*

$$\begin{aligned} 4 \text{ men} & 6 \text{ hours} \\ 2 \text{ men} & = 12 \text{ hours} \\ 1 \text{ man} & = 24 \text{ hours} \end{aligned}$$

$$1 \text{ man} = 24 \text{ hours}$$

$$1 \times 9 \text{ men} = \frac{24 \text{ hours}}{4}$$

$$9 \text{ men} = 2.66 \text{ hours}$$

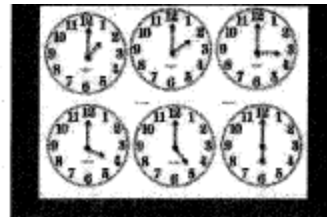
Step ①: Find how long it takes 1 person

$$\frac{\text{people}}{\text{hours}} = \frac{4}{6} = \frac{8}{12} = \frac{1}{\boxed{1.5}}$$

← The more people, the less time, and vice versa, so
if I multiply the # of people, I have to divide the # of hours.

Step ②: Find how long it takes 9 people

$$\frac{\text{people}}{\text{hours}} = \frac{1}{1.5} = \frac{9}{2.7} \leftarrow \text{I will round } 2.7 \rightarrow 2.7 \text{ (270 minutes)}$$



Step ③: Make mixed # (optional)

$$\frac{270}{100} = \frac{54}{20} = \frac{162}{60} = 2 \frac{42}{60}$$

20 goes into 60 easily

$2 \frac{42}{60}$ is the same as 2 hours and 42 min.

If it takes 4 people 6 hours to repair a road, how long will it take 9 people to do the job if they work at the same rate?

so it would take 9 people ^{about (we rounded 2.7)} 2 hours and 42 min to do the job

My answer is reasonable because...
with one less person,

$$\frac{\text{people}}{\text{hours}} = \frac{4}{6} = \frac{8}{3} \quad \text{It will take a bit less than 3 hours.}$$

If it takes 4 people 6 hours to repair a road, how long will it take 9 people to do the job if they work at the same rate?

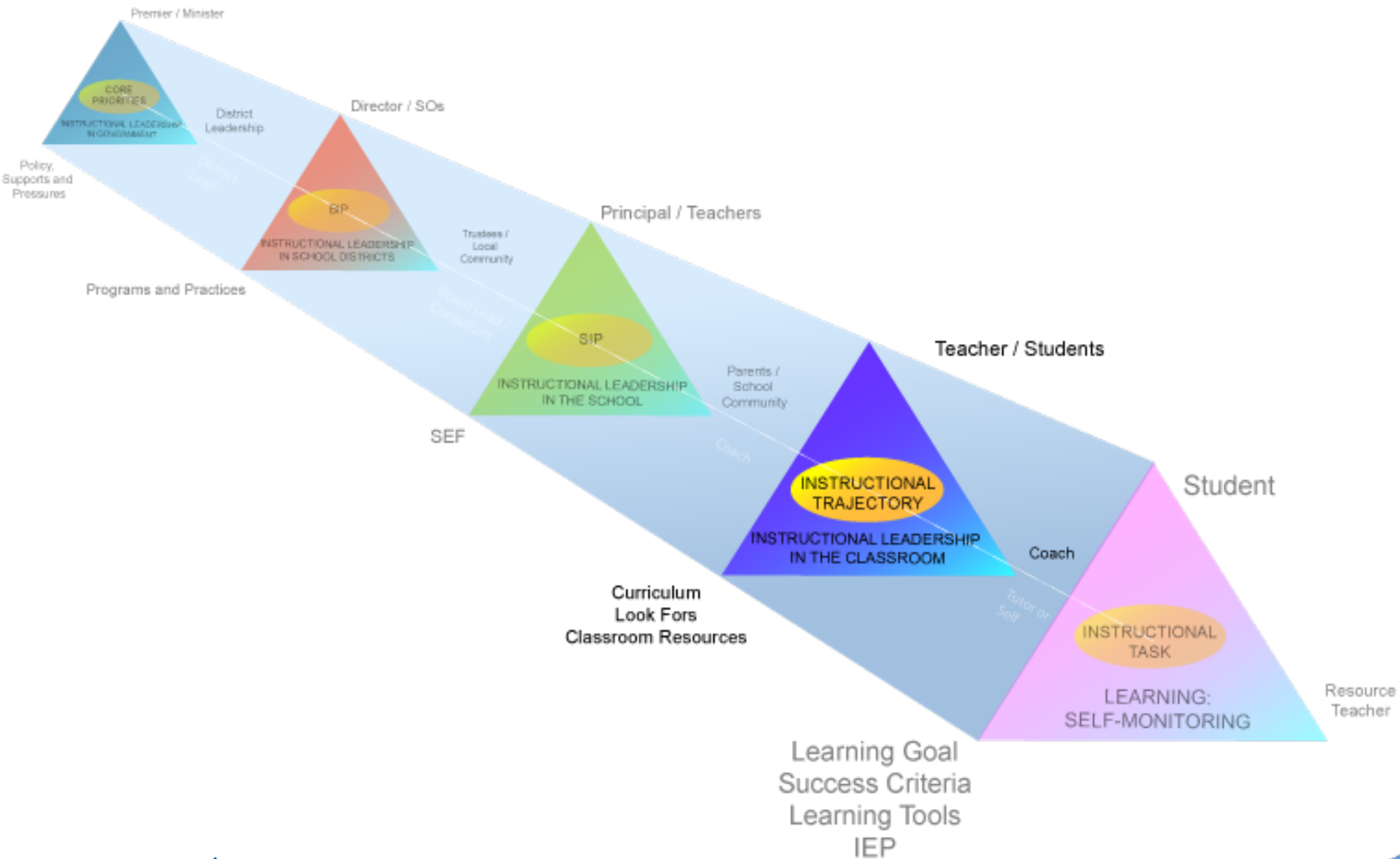
It will take the same amount of time because 4 people who are hard workers, would move at the same rate as 9 lazy guys.

4 people 1 hr 50 min each

9 people

∴ it would take both amount of people the same time





Strategies

- Factor of Change
- Additive
- Scaling Up
- Unit Rate
- Others?

Consolidate

Mrs. Gordon can complete a job two times faster than Mr. Gordon. If they worked together on a job, how long will it take for them to finish the job?

Mrs. Gordon can complete a job two times faster than Mr. Gordon. If they worked together on a job, how long will it take for them to finish the job?

Know

- Mrs. Gordon works 2x faster than Mr. Gordon

Find

- When they work together on a job, how long will it take to finish?

Try

- Use examples and make assumptions to try to determine the answer.

I know that Mr. Gordon always works with half the time it would take her wife. For example, if a job takes 20 minutes to complete when Mr. Gordon does the job, it would only take his wife 10 minutes to complete the job. I could use a chart to display this information but I think it is already comprehensible and that I know that the rule would be $2n$ ($n = \text{Mr. Gordon}$).

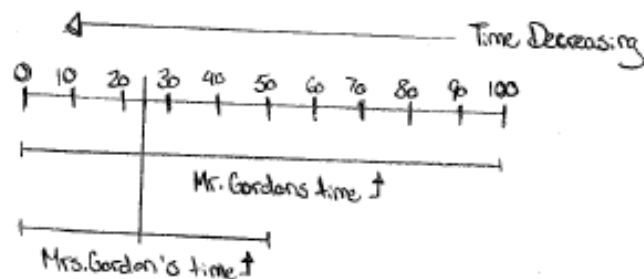
Example

This job usually takes 100 seconds to complete.

Mr. Gordon: 100 seconds to complete the job.

Mrs. Gordon: 50 seconds to complete the job.

Working together: I think it will take 25 seconds to complete the job.



Time it Usually Takes to Complete Job (C)	Mr. G's time to Complete (n)	Mrs. G's time to Complete (2)	Time to Complete Working together (t)
100	100	50	25
50	50	25	12.5
10	10	5	2.5
20	20	10	5
2	2	1	0.5
1	1	0.5	0.25
.	.	.	.
$C=n$	$n=C$	$n \div 2$	$C \div 4$

Equations with the chart

$$t = 2 \div 2$$

$$= C \div 4$$

$$= n \div 4$$

I made an assumption that the time it usually takes to complete the job was the time it took Mr. Gordon to do the job. I knew that the time it took working together would be less than Mrs. Gordon's time and relevant to both.

Mrs. Gordon can complete a job two times faster than Mr. Gordon. If they worked together on a job, how long will it take for them to finish the job?

Solution #1

Mrs. Gordon - 5 min.

Mr. Gordon - 10 min.

I am going to find
the average of 5 and 10

$$5 + 10 = 15$$

$$15 \div 2 = 7.5$$

∴ If they worked together it would
take about 7 and $\frac{1}{2}$ minutes.

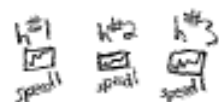
Check: This is not reasonable because
Mrs. Gordon can do it by
herself faster, so if they
worked together it should
take less than 5 min.

Mrs. Gordon can complete a job two times faster than Mr. Gordon. If they worked together on a job, how long will it take for them to finish the job?

It would take them $\frac{1}{3}$ of the time of just Mr. Gordon.

for example, if Mr. G and Mrs. G worked at a 3 hour task at the same time, and they both worked for 1 hour, then Mr. G would do 1 hour worth of work and Mrs. G would do 2 hours worth. Whereas if just Mr. G worked, he would work for 3 hours to get the work done.

Mr. G



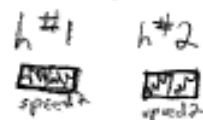
$$\begin{aligned} & (\text{Mr. G } h\#1 + \text{Mrs. G } h\#1) \\ & = \text{speed1} + \text{speed2} \\ & = \text{speed3} \end{aligned}$$

Mr. G + Mrs. G

Mr. G

$$\begin{aligned} & 1 \div 3 \\ & = \frac{1}{1} \div \frac{3}{1} \\ & = \frac{1}{1} \left(\frac{1}{3} \right) \\ & = \frac{1}{3} \end{aligned}$$

Mrs. G



Mr. G + Mrs. G



An example of where a situation like this might show up is if Mr. and Mrs. Gordon worked at a candy making factory. Say they needed to make 300 pieces of candy. Mr. G could make 100 per hour, so Mrs. G could make 200. If they worked at different stations so they couldn't slow each other down and they were both reaching for the same goal of 300 candies together, they could complete it in one hour.

Mrs. Gordon can complete a job two times faster than Mr. Gordon. If they worked together on a job, how long will it take for them to finish the job?

know: Mrs. Gordon can complete a job 2 times as fast as Mr. Gordon.

Find: If they work on a job together how long would it take?

Try: ① - create a table, one column Mr. G. another Mrs. G. and one for the two it takes together.

② - find a number that is halfway between the two numbers because Mr. G. might slow Mrs. G. down

Method 1

Time it takes Mr. G.	Time it takes Mrs. G.	Time it takes together
1 hour	30 mins	20 mins
3 hours	1h 30m	1h
1 year	182.5 days	121.66
3 years	1 year 182.5 days	1 year

The chart to the left shows the time a task would take Mr. G, Mrs. G, and them together.

To find how long it took them together, I found one third of how long it took Mr. G.

this is how I came to this method:

$$\begin{aligned} \text{Mr. G.} &= \text{speed } 1 (51) = 1\text{h} \\ \text{Mrs. G.} &= \text{speed } 2 (51) = 30\text{m} \left(\frac{1}{2} \text{ an hour} \right) \end{aligned}$$

Example:

$$\begin{aligned} \text{total time together} &= 51 + 52 \\ &= 53 \\ &= \frac{1}{3} \text{ of } 51 \\ &\quad \uparrow \\ &\quad (\text{speed } 3) \end{aligned}$$

* This is my first method and Method 2 makes more sense because I revised it.



Mrs. Gordon can complete a job two times faster than Mr. Gordon. If they worked together on a job, how long will it take for them to finish the job?

Method 2
Possibly, because Mrs. Gordon does jobs 2 times faster than Mr. Gordon.
Bringing Mr. Gordon in will slow down Mrs. G.

(G)	(S)	(T)
Mr. G.	Mrs. G.	Together
1 hour	30 min	45 min
4 h	2 h	3 h
1 min	30 seconds	45 seconds
10 min	10 min	15 min
70 min	20 min	30 min
4 years	2 years	3 years
80 years	40 years	60 years

Rule $T = \frac{(G + S)}{2}$

$$= \frac{6 \times 1.5}{2}$$

$$= 6 \times 0.75$$

$$= T$$

$T = 6 \times 0.7$

Mrs. Gordon can complete a job two times faster than Mr. Gordon. If they worked together on a job, how long will it take for them to finish the job?

Assumptions: If Mr. G's cleaning time = x , and Mrs. G's cleaning time is twice as fast. That equals $2x$.

So... $2x + x = 3x$

- their combined job working speed = $3x$, they
- will complete a job 3 times as fast together compared to Mr. G's job finishing speed. Also their speed is 1.5 times as fast compared to Mrs. G doing all the work.

Assumptions: If a job took Mr. G one hour to complete, how much faster is their combined work and Mrs. G's speed?

Mrs. G = 2 times as fast
as Mr. G.
 $= 1 \text{ hour} \div 2$

Mrs. G = 30 minutes
to complete
the job

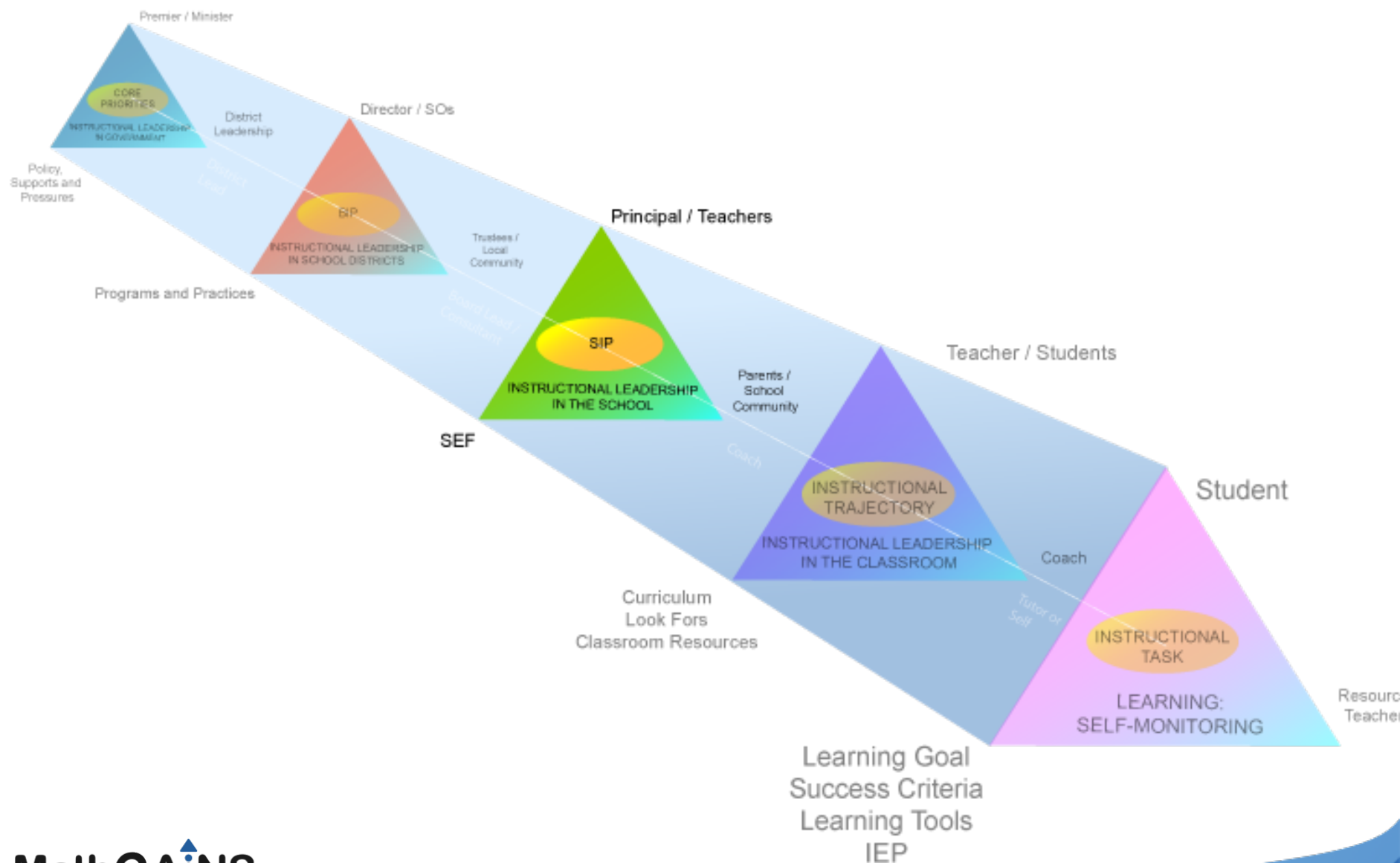
Mr. G + Mrs. G = 3 times as fast as Mr. G
and 1.5 times as fast as Mrs. G.
 $= 1 \text{ hour} \div 3$

Mr. G + Mrs. G = 20 minutes to complete the job

○ it would take Mrs. G
30 mins to finish and
with their combined speed
it takes them 20 mins.

Consolidate

- Do you think that the time will be between Mrs. Gordon's alone time and Mr. Gordon's alone time?
- Whose time do you think it will be closer to? Why?
- Can we use average amount of work to find a solution?



Where's the math?

- students tend to over "linearize" situations, i.e. assume proportionality when it isn't there (this one is inverse proportion)
- this is what is called an inverse proportion
- students need to estimate to see if their answers make sense
- fractions and ratios can be related to division
- a "unit" analysis can be a useful math strategy, e.g. $\text{hours} = \text{man} \times \text{hours} \div \text{men}$, so the number of hours = 4 men x 6 hours ÷ 9 men

Success Criteria

- ensuring that an exact answer makes sense (even though we didn't say that in the question itself, it should be implicit in all math work), both in terms of type of number, unit and size of number
- estimating an answer using good reasoning is a long way toward being successful
- any proportions/ratios/equations set-up that makes sense, helps thinking and shows thinking

Questions (Administrators)

- How did you group your students and why?
- How much did you scaffold and how?
- How much probing did you do?
- How did you respond to student ideas?
Solutions?

Questions (Administrator)

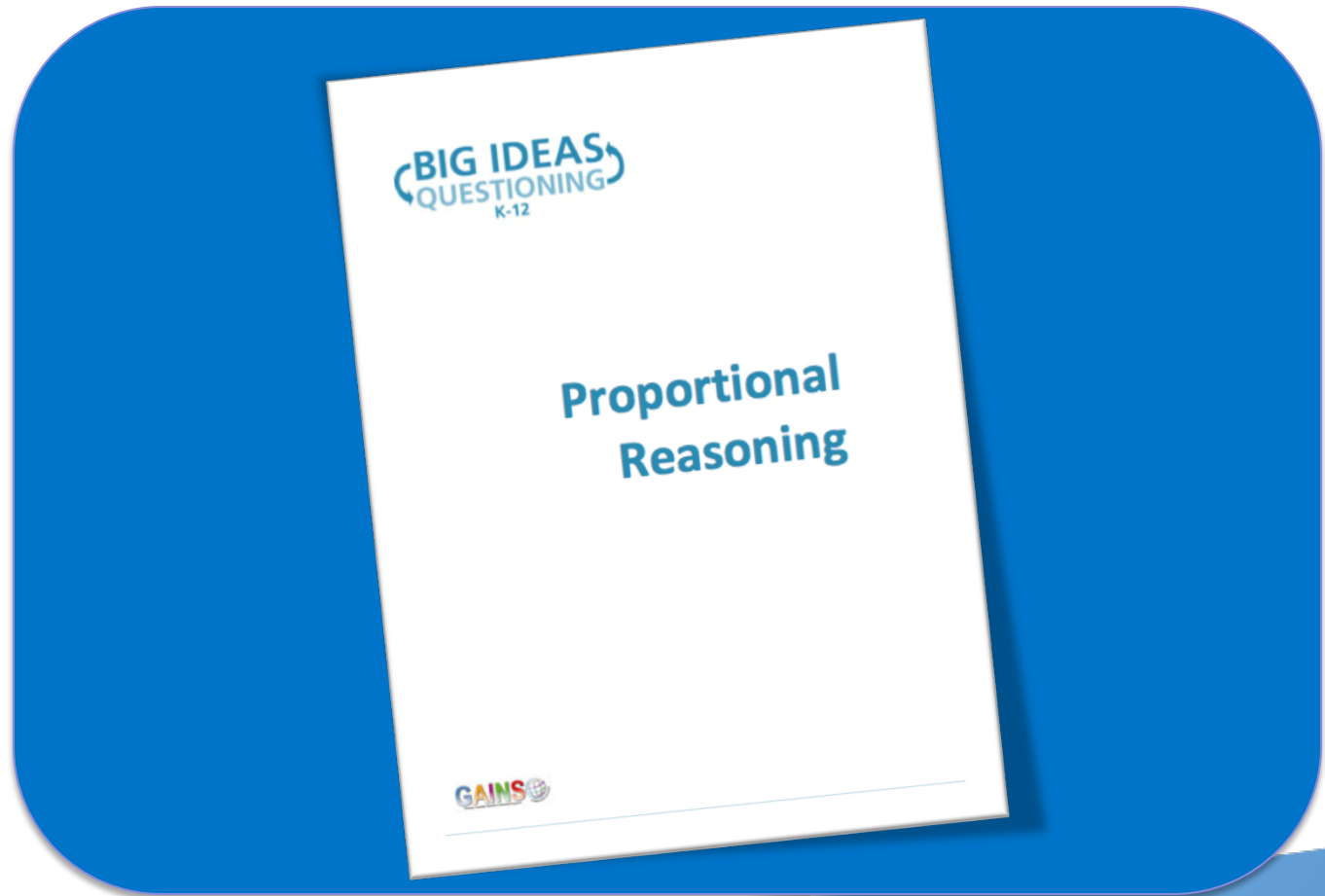
- What was one mathematical idea you wanted your students to learn? How did you ensure that?
- How did your questions help you know the learning goal was met?
- Why was that an important math learning goal?

Administrator Look-Fors for Effective Math Instruction

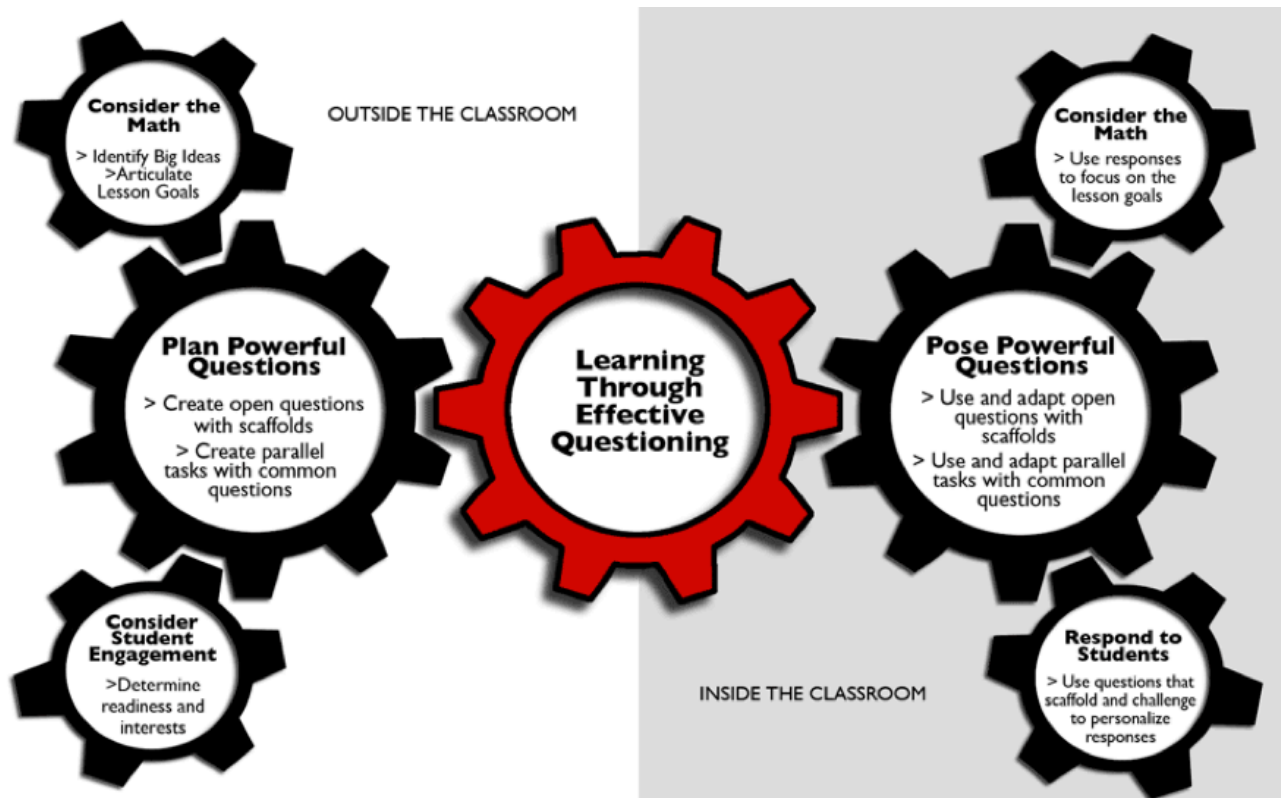
- View video.



Proportional Reasoning Continuum and Connections



Effective Questioning



Consolidate and Reflect

- What did you hear today that changes or confirms the way you support teaching and learning mathematics in your school?
- What should you do differently and what do you need to do it?
- How does today's session connect to your School Improvement Plan for Student Achievement?

Contact us!

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